

Effect of Motorized Scooters on Quality of Life and Cardiovascular Risk

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Physical inactivity increases cardiovascular risk. The possible adverse effects of regular motorized scooter use, recently popularized for patients with physical limitations, has not been previously examined. We performed a single-center, retrospective cohort study of 102 consecutive patients who had obtained medical approval for, and subsequently received, a motorized scooter during a 6-year period. The clinical data were collected for the 12 months before and after the intervention. Surveys assessing 11 different facets of health-related quality of life were returned by 28% of patients. The patients receiving a scooter were 68 ± 19 years old, and 55% were women. The medical indications for scooter use, by decreasing frequency, were disabling arthritis, chronic lung disease, neurologic disorders, and heart failure. Patients returning the surveys estimated scooter use at a median of 4 hours/day, with walking confined to 30 min/day. Despite significant physical and psychological improvements in all quality-of-life categories ($p < 0.001$), the fasting blood glucose increased from 119 ± 39 to 133 ± 49 mg/dl ($p = 0.009$), hemoglobin A1c increased from 6.3 ± 0.8 to 6.8 ± 1.2 ($p = 0.019$), and 18.7% of patients developed diabetes during the follow-up period. No significant changes in blood pressure were noted, although 20% of patients required additional antihypertensive medication. Despite improvements in total and low-density lipoprotein cholesterol over time, 50% of dyslipidemic patients required either an increase medication dose or additional medications during follow-up. In conclusion, interventions, such as scooters, that improve self-perceived quality of life, can have detrimental long-term effects by increasing cardiovascular risk, particularly insulin resistance. Physicians should carefully weigh such risks before approving their use, as well as ensure healthy levels of activity afterward. Published by Elsevier Inc. (Am J Cardiol 2010; 105:672–676)

In recent years, motorized scooters or platform-motorized wheelchairs have been popularized as a method of improving the quality of life of patients through improved mobility. Physicians regularly prescribe these devices, despite little evidence supporting a benefit and with great expense to patients and the healthcare system in general. A review of MEDLINE from 1969 to the present with the search criteria “motorized wheelchair OR scooter OR platform motorized wheelchair” failed to reveal any studies documenting that these devices were effective in improving the quality of life of the patients who received them. In addition, it is unclear whether by providing platform motorized wheelchairs, physicians are further promoting inactivity and inadvertently increasing patients’ cardiovascular risk. A single-center, retrospective, cohort study was therefore designed to assess the effect of motorized scooter use on patient-perceived quality of life. The study was also designed to examine how these devices, which have the potential to

reduce the level of physical activity, affected the well-established cardiovascular risk factors.

Methods

All patients who receive motorized scooters at Wilford Hall Medical Center and Brooke Army Medical Center in San Antonio, Texas require previous approval from the physical medicine and rehabilitation department. All consultations placed to that department for platform motorized wheelchair devices during a 6-year period (June 1998 to June 2004) were reviewed. From this group, a final cohort of 102 patients was identified who had been medically approved and had received a scooter during this period. Our institutional review board fully reviewed and accepted the protocol under exemption status.

An 11-item survey (Figure 1) was mailed to each patient, and they were given the option to withdraw their participation from the study at that time. Because no recognized survey tested for reliability and validity had been previously developed to examine patients receiving platform motorized wheelchairs or other mobility-assist devices, a quality-of-life survey (Figure 1) was created under the guidance of our institutional review board. The survey was intended to evaluate the patients’ self-perceived changes in physical and psychological well-being before and after receiving the motorized scooter. In addition to collecting baseline demographics, the patients

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| Please answer the following questions on the scale indicated (circle one number in each column for each question): | BEFORE the Motorized Wheelchair / Scooter 1 = Very Poor 10 = Excellent | AFTER the Motorized Wheelchair / Scooter 1 = Very Poor 10 = Excellent |
|--|--|---|
| 1. How would you rate your overall quality of life before and after the scooter? | 1 2 3 4 5 6 7 8 9 10 | 1 2 3 4 5 6 7 8 9 10 |
| 2. How would you rate your ability to do your household chores? | 1 2 3 4 5 6 7 8 9 10 | 1 2 3 4 5 6 7 8 9 10 |
| 3. How would you rate your ability to participate in pastimes and hobbies? | 1 2 3 4 5 6 7 8 9 10 | 1 2 3 4 5 6 7 8 9 10 |
| 4. If you work, how would you rate your ability to perform your job? (Leave blank if you don't work) | 1 2 3 4 5 6 7 8 9 10 | 1 2 3 4 5 6 7 8 9 10 |
| 5. How would you rate your ability to live independently? | 1 2 3 4 5 6 7 8 9 10 | 1 2 3 4 5 6 7 8 9 10 |
| 6. How would you rate your ability to go shopping for groceries, clothes, etc. | 1 2 3 4 5 6 7 8 9 10 | 1 2 3 4 5 6 7 8 9 10 |
| 7. How would you rate your burden to your family? (1=great, 10=none) | 1 2 3 4 5 6 7 8 9 10 | 1 2 3 4 5 6 7 8 9 10 |
| 8. How would you rate your ability to make it to doctors appointments and other appointments? | 1 2 3 4 5 6 7 8 9 10 | 1 2 3 4 5 6 7 8 9 10 |
| 9. How would you rate your ability to visit friends and family? | 1 2 3 4 5 6 7 8 9 10 | 1 2 3 4 5 6 7 8 9 10 |
| 10. How would you rate your overall physical health? | 1 2 3 4 5 6 7 8 9 10 | 1 2 3 4 5 6 7 8 9 10 |
| 11. How would you rate your overall feelings of mental well-being? | 1 2 3 4 5 6 7 8 9 10 | 1 2 3 4 5 6 7 8 9 10 |

Figure 1. Survey used to assess changes in quality of life resulting from motorized scooter use.

were asked why they had required a scooter and how many hours per day they used the device. They were also asked to quantify how many minutes they walked per day and how often they exercised in the year after receiving their scooter.

An intensive electronic and paper medical record review was then conducted of each patient, and data were collected from the 12-month period before and the 12-month period after the date the patient had received a motorized scooter. Relevant cardiovascular data were collected, including body weight and body mass index, cholesterol profile, office blood pressure measurement, and fasting glucose level. Hypertension was defined as actively taking antihypertensive medication and/or a systolic blood pressure of ≥ 140 mm Hg on ≥ 2 occasions. Dyslipidemia was defined as a total cholesterol level of 240 mg/dl or the need for lipid-lowering therapy. Renal insufficiency was defined as a creatinine clearance of < 60 ml/min.

Because medications can have a major effect on these risk factors, we examined the absolute number of medicines and the dosages of all hypertensive, diabetic, and lipid-modifying drugs during these periods. By collecting data for the 12 months proceeding scooter implementation, we were able to establish a baseline of cardiovascular risk factors and assumed that any changes in the subsequent year would most likely reflect lifestyle changes resulting from use of the device. If more than one measurement was available during the examined periods, the levels were averaged, and the average value was used for the purposes of the analysis.

Electronic and chart data were collected into 2 separate spreadsheets by different reviewers, and any differences were resolved by a re-examination of the raw data. In the rare event of missing data, the analyses were performed only for those patients with paired data (data from blood tests performed both before and after scooter use). The data were compiled and analyzed using a statistical software package (Statistical Analysis Systems, version 8.2, SAS Institute, Cary, North Carolina). A comparison of the continuous variables was performed using paired and 2-sample *t* testing and a comparison of dichotomous variables using the chi-square test or Fisher's exact test, as appropriate. A comparison of noncontinuous variables was performed using the Wilcoxon signed rank test. Data are presented as the mean \pm SD for continuous variables, as the number (percentage) for dichotomous variables, and as the median and range for noncontinuous variables. *p* Values < 0.05 were considered statistically significant. For multiple comparisons of laboratory values, a Bonferroni adjustment was used.

Results

From June 1998 to June 2004, 102 patients were identified who had received medical approval for, and subsequently received, a motorized wheelchair. The medical indications for scooter use by decreasing frequency were disabling arthritis (39%), chronic lung disease (25%), neurologic disorders (18%), and heart failure (14%). Of the 102 patients in this cohort, 29 returned

Table 1
Baseline clinical and demographic characteristics

| Variable (n = 103) | Value |
|-------------------------------|----------|
| Age (years) | 68 ± 18 |
| Weight (lb) | 184 ± 36 |
| Men | 45% |
| Hypertension | 58% |
| Hyperlipidemia | 30% |
| Diabetes | 38% |
| Active smoker | 14% |
| Previous smoker | 35% |
| Known coronary artery disease | 40% |
| Renal insufficiency | 23% |

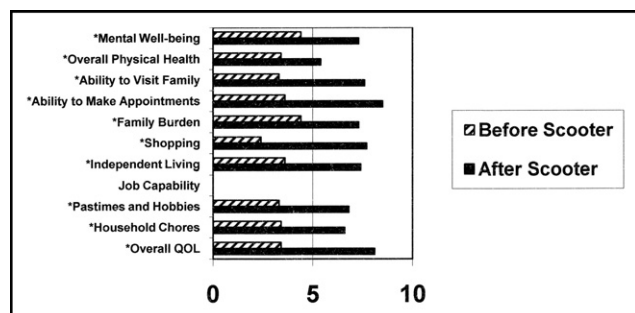


Figure 2. Results of quality-of-life survey. Patient self-described abilities to perform vital life activities before and after receiving scooters. *p < 0.05. QOL = quality of life.

completed surveys and estimated their scooter use at a median of 4 hours daily (range 1 to 10), with walking confined to 30 min/day (range 0 to 300) and formal exercise to a median of 6 min/day (range 0 to 60). All but 1 patient were still regularly using the scooter at follow-up completion. The baseline clinical characteristics of the population are listed in Table 1.

Of the 102 patients, 29 (28%) returned the quality-of-life survey sent to their mailing address. On a scale from 1 ("very poor") to 10 ("excellent"), a statistically significant, self-perceived improvement was noted in all quality-of-life facets tested, with the exception of improvement in the ability to perform their job (all patients surveyed reported they were no longer employed). The results of the survey are summarized in Figure 2. The patients generally reported a near doubling in their quality-of-life scores, with the most notable improvements seen in overall physical health (improving from a median of 3 to a median of 6, $p < 0.001$), the ability to go shopping (improving from 2 to 7, $p < 0.001$), and overall self-perceived quality of life (improving from 3 to 8, $p < 0.001$). Every patient returning a survey reported that the scooter had improved at least one facet of their quality of life, and no patient reported worsening in any single component of their physical or mental well-being.

The results of the cardiovascular risk assessment before and after scooter implementation have been summarized in Figure 3. No difference was found in body weight during the study period (183 ± 36 at baseline and 183 ± 32 lb after

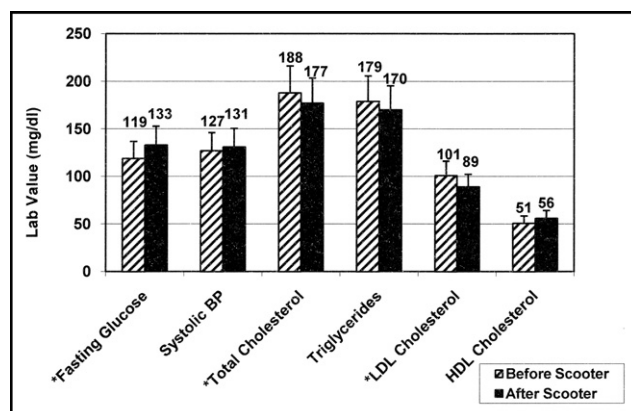


Figure 3. Results of cardiovascular risk assessment. Measured laboratory values and systolic blood pressure before and after patients received scooters. All measures in mg/dl except for systolic blood pressure (mm Hg). *p < 0.05. BP = blood pressure; HDL = high-density lipoprotein; LDL = low-density lipoprotein.

receiving the motorized scooter). The fasting glucose level increased from 119 ± 39 mg/dl at baseline to 133 ± 49 mg/dl during follow-up ($p = 0.008$), hemoglobin A1c increased from 6.3 ± 0.8 to 6.8 ± 1.2 ($p = 0.019$), and the prevalence of diabetes increased from 38% to 57% ($p = 0.010$). The systolic blood pressure did not appreciably change after receiving the scooter (127 ± 17 to 131 ± 22 mm Hg, $p = 0.49$), but 20% of patients with hypertension at baseline required the addition of new blood pressure medications or increased dosages of their existing blood pressure medications during the follow-up period. In these patients, the median number of antihypertensive agents increased from 1.5 ± 0.7 to 1.8 ± 0.9 , ($p = 0.02$). Total cholesterol decreased from a mean baseline of 188 ± 43 mg/dl to 177 ± 40 ($p = 0.004$) and low-density lipoprotein cholesterol decreased from 101 ± 30 to 89 ± 29 mg/dl ($p = 0.002$). However, this occurred in the context of 30% of patients having increased the dosage of their baseline lipid medications, 10% of patients beginning statin therapy, 5% starting a fibrate, and 4% who initiated niacin therapy. Triglycerides (179 ± 96 to 170 ± 107 mg/dl, $p = 0.44$) and high-density lipoprotein cholesterol (51 ± 20 to 56 ± 37 mg/dl, $p = 0.27$) did not change appreciably.

Discussion

Our results have demonstrated for the first time that the use of a modern medical convenience, a motorized scooter, might have a detrimental effect on insulin resistance and other established cardiovascular risk factors. This occurred despite the perception from patients that scooter use improved their overall quality of life. It is important to recognize that for some patients, particularly those with degenerative neurologic disorders, a scooter might greatly facilitate the necessary activities of daily life. In these patients, the use of a scooter is unlikely to negatively affect their overall physical activity and is therefore unlikely to greatly alter their cardiovascular risk. It is probable that the exclusion of these patients from the analysis would have further strengthened the

negative effect of the diminished physical activity resulting from scooter use. Despite the inherent limitations of self-reporting, patients generally noted very little physical activity after receiving their scooters. Also, for 3 of the 4 most common primary indications listed for scooter use in our cohort (ie, arthritis, chronic lung disease, and heart failure), regular physical activity has previously been shown to improve the clinical outcome.¹⁻³

Physical activity is known to have multiple metabolic and cardiovascular effects. In patients with type 2 diabetes, moderate, regular exercise, even without weight loss, has several effects on muscle function that improves insulin sensitivity,⁴ including an increase in the quantity of mitochondrial enzymes and "slow-twitch" muscle fibers,⁵ the development of new muscle capillaries, and an increase in the translocation of insulin responsive glucose transporters that promote glucose uptake.⁶ A meta-analysis of controlled trials examining the effect of exercise in patients with type 2 diabetes found that exercise training reduced hemoglobin A1c values by 0.7% and improved glycemic control in the absence of significant weight loss.⁷ Exercise has also been shown to have an independent graded effect on cardiovascular outcomes in patients with type 2 diabetes.⁸ In our study, almost 1/5 of our patients developed diabetes after 1 year of reduced physical activity. Regular exercise has been shown to significantly decrease both systolic and diastolic blood pressure, independent of weight loss.⁹ Although the mechanism responsible for this finding is not completely understood, exercise reduces the circulating levels of norepinephrine and has been shown to augment endothelium-dependent vasodilation through increased production of nitric oxide.¹⁰ In our study, reduced activity in our patients with hypertension patients resulted in 20% requiring up titration of their antihypertensive medication. Exercise, together with diet, has been shown to increase serum high-density lipoprotein cholesterol, high-density lipoprotein 2 cholesterol, and apolipoprotein A-1 concentrations compared to diet alone.¹¹ The possible mechanisms include an increase in lipoprotein lipase activity and reduced hepatic lipase activity,^{12,13} and a reduction in cholesteryl ester transfer protein concentration, and an elevation in serum lecithin cholesterol acyltransferase concentration.^{14,15} Exercise also reduces serum triglycerides and total serum cholesterol and might also decrease low-density lipoprotein cholesterol concentrations.¹⁶ The latter effect appears quite small, but it might have a greater effect on the chemical composition of the low-density lipoprotein molecule with increased low-density lipoprotein-free cholesterol, cholesterol ester, and phospholipid content.^{17,18} Because our study was limited to traditional lipid panel measures, it is possible the latter changes were missed. The total cholesterol levels actually decreased in patients receiving scooters, although changes in the National Cholesterol Education Panel guidelines occurred during our study and likely resulted in more aggressive therapy.^{19,20} Supporting this theory is that 50% of all of our patients required either the start of new lipid-modifying medications or increases in the doses of their medications during the follow-up period.

Our study had some inherent limitations. It was retrospective, and no control group was involved. A prospective, randomized, controlled study of cardiovascular risk and quality-of-life factors in patients receiving motorized scooters should be considered on the basis of our results. Our quality-of-life survey had not been previously studied to assess its reliability and validity, although we made every effort to make it effective by basing it on a previously recognized quality-of-life instrument (Minnesota Living with Heart Failure Questionnaire) and developing it with third party guidance from our institutional review board. Finally, trying to determine objective changes in cardiovascular risk factors was difficult in the present study. First, a 1-year period is a short interval for assessing changes in cardiovascular risk (although we purposely kept the follow-up period short to ensure that any changes predominately resulted from the scooter intervention and not natural disease progression). Second, all of our patients received good primary follow-up care and medications were added and up titrated, obviating some of the adverse effects related to inactivity.

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